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ABSTRACT

This newsletter theme issue includes six articles on improving math and science education, particularly for poor, Limited-English-Proficient (LEP), and female students. "Effective Math and Science Instruction--The Project Approach for LEP Students" (Joseph Vigil) describes how hands-on science projects can increase student motivation, drive math and science content, and foster development of English-language math and science vocabulary. "Power Tools for Math and Science Education, Part I" (Laura Chris Green) describes promising technology tools for math and science education, including: software for test preparation; tutorials; games to teach skills, concepts, and problem solving; and applications and modeling. "What Is the Matter with Math Scores?" (Cathy Seeley) discusses U.S. and Texas mathematics achievement scores in terms of what is working (improved teaching methods, professional development) and what is not (teaching to the test, fragmented instructional approaches). In "A Central Role for Science Education Partnership," Eloy Rodriguez reflects on the successes of a school-university partnership to provide poor Latino children with a challenging university-based science "camp." "'Sugar and Spice and Everything Nice...': Gender Inequities in Mathematics" (Anita Tijerina Revilla) discusses sex bias in the classroom and useful strategies to involve girls in mathematics. "Texas Prefreshman Engineering Program: Filling the Pipeline for Workforce Diversity" (Manuel P. Berriozabal) describes an intense 8-week summer program that prepares high-achieving minority and female high school students to pursue college engineering and science studies. A sidebar "Make No Mistake: The Goal Is Equity" (Bradley Scott) describes equity goals of the IDRA Desegregation Assistance Center. Also included are a description of WOW (IDRA's workshop on workshops) and a list of educational Web sites for math and science education. (SV)

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INTERCULTURAL DEVELOPMENT RESEARCH ASSOCIATION

IDRA Newsletter

IDRA Focus: Math and Science

ISSN 1069-5672 Volume XXV, No. 3 March 1998

ED 417 920

Effective Math and Science Instruction – The Project Approach for LEP Students

Joseph Vigil, M.S.

Inside this Issue:

- Instructional technology tools
- Successful programs
- Gender inequity in math
- Innovative training of trainers

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

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The "project approach" to instruction is becoming popular for providing enriching, cognitively demanding experiences for limited-English-proficient (LEP) students. The project approach involves any type of group learning activity that brings about a sustained period of self-reliant effort by learners to achieve a clearly defined goal.

The approach is most productive to invite students to express themselves in the language they use most comfortably. While extra time may be needed for translation so that all students can understand each other, the benefit is that students are learning to communicate using math and science language that can be transferred as students' English proficiency increases. The translation process can produce greater English fluency. Homework that takes the form of hands-on projects and problem solving promotes students' language and thinking skills and helps parents support the value of learning math and science for real-world applications.

The language needed to communicate ideas in math and science classes can be difficult for LEP students to master. Science vocabulary is key to most science instruction. By one estimate, students in the average high school biology class are exposed to more than 2,400 new terms in one year – more new words than they would be asked to learn in the typical high school French class (Vigil, 1996).

The hands-on project approach can motivate all students to communicate using math and science language in order to produce a final product. For example, teachers in Gallup, New Mexico, are receiving training from the Intercultural Development Research Association (IDRA) on how to implement the project approach to enhance instruction and motivate students to learn math and science concepts.

"We put students first here in Gallup and will adopt strategies that will enhance student learning and achievement," said Melinda Swain, coordinator for language acquisition and staff development for the Gallup-McKinley County Schools (CS). Teachers are not throwing away their textbooks. They are using the solar car project to demonstrate real-world applications of key concepts and to have students communicate these concepts while participating in social interactions with other students, teachers and mentors.

The solar car project approach covers valuable real-world engineering design experiences, math and science concepts, and other experiences including:

Engineering Design Experiences

- Definition of customer and needs
- Performance criteria and contacts
- Research
- Synthesis
- Analysis
- Design
- Prototype construction
- Testing
- Evaluation
- Presentation

Math and Science Concepts

- Metric units
- Force at a point
- Circumference (radius times two times π)

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The Intercultural Development Research Association *(IDRA)* is a non-profit organization with a 501(c)(3) tax exempt status. The purpose of the organization is to disseminate information concerning equality of educational opportunity. The *IDRA Newsletter* (ISSN 1069-5672, copyright ©1998) serves as a vehicle for communication with educators, school board members, decision-makers, parents, and the general public concerning the educational needs of all children in Texas and across the United States.

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Effective Math and Science *- continued from page 1*

- Torque (force times lever arm; T=FL)
- Gear ratio
- Velocity (V=D/t)
- Revolutions (rotations per minute or radians per second)
- Friction
- Center of gravity
- Graphing
- Frontal area
- Specific weight of air
- Acceleration of gravity
- Aerodynamic drag
- Solar panel and motor

Other Experiences

- Working as members of a team
- Troubleshooting experiences
- Sportsmanship
- Promoting an event
- Knowing it is okay if something does not work
- Working with Sprint solar car software
- Internet research

Students have such a good time with the project that they often do not see the math and science as school work, but as a tool to create a product. The project drives the math and science content, and communication increases, fostering greater English fluency for LEP students as well as for all students involved. Administrators and parents in Gallup will assist since the solar car project can culminate in a solar car competition that requires many volunteers and assistance from outside the classroom. Community and local businesses will contribute by providing support for the promotion of the event.

Technology is not just something added to this project approach. It is truly integrated into every aspect of the experience. Students will use solar car software that animates key science and math concepts to provide them with background information. The National Renewable Energy Laboratory will provide on-line research for students at <www.nrel.gov>. Photovoltaic information for teachers and students is featured in an on-line quiz found at <www.nrel.gov./pv/whatispv.html>. An example of student work may be viewed on Chris and Grant's Solar Page at <www.teleport.com/~chrisdb/project>. This student page was created for a school science project and provides background information on photovoltaic cells, home applications and solar car highlights.

On-line mentors will be utilized to assist students and teachers with the project. Engineers from the Los Alamos National Laboratory will provide expertise on the mechanics of the solar car project and the overall design process. Professional staff from IDRA and the Southwest Comprehensive Center Region IX will provide Gallup-McKinley CS teachers with on-line expertise on topics such as the following:

- Bilingual education and English as a second language (ESL),
- Education technology,
- Instruction and curriculum,
- Multicultural education,
- Family involvement and participation,
- Professional development, and
- Evaluation and assessment.

Two resources that provide educators with ESL strategies are *Teaching Content: ESL Strategies for Classroom Teachers* and *Starting Today...Steps to Success for Beginning Bilingual Educators* developed by Frank Gonzales, Ph.D., a senior education associate at IDRA. These resources point out that the most important tenet of bilingual education is that knowledge is transferable. Content area instruction early in school should be done in the primary language to develop a strong cognitive base in one language, which then transfers to the second language.

The project approach can enhance students' learning of math and science concepts. It provides a rich environment for using math and science language that can be transferred as students' English proficiency increases.

Resources

Gonzales, F. *Starting Today...Steps to Success for Beginning Bilingual Educators* (San Antonio, Texas: Intercultural Development Research Association, 1995)

Gonzales, F. *Teaching Content: ESL Strategies for Classroom Teachers* (San Antonio, Texas: Intercultural Development Research Association, 1995)

Vigil, J. "What is Science Literacy?" *IDRA Newsletter* (San Antonio, Texas: Intercultural Development Research Association, November-December 1996)

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COMING UP!

In April, the *IDRA Newsletter* focuses on young children.

Power Tools for Math and Science Education, Part I

Laura Chris Green, Ph.D.

All students deserve to experience a world-class education in math and science. We can no longer afford to exclude girls, minority students, speakers of other languages and special needs students from the opportunity to pursue advanced math and science interests. Instructional technology can help schools achieve excellence and equity in the areas of math and science.

This two-part article describes technology tools for math and science education that are currently available and seem especially promising for enhancing instruction. These tools are not to replace teachers – because I believe that is neither possible nor desirable (Green, 1995) – but to give effective math and science teachers power tools to increase their creativity, accuracy and efficiency.

The Power Tool Analogy

My husband is a carpenter. He has built houses from the ground up and created beautiful, custom-designed furniture. In his strong, capable hands, an ordinary piece of pine or oak becomes a work of art that will last for centuries. In his mastery of woodworking, he uses a large variety of hand tools such as chisels, scrapers and saws. But it is his *power tools* that he seems to treasure. He always wants to buy just one more drill, router, shaper or electric screwdriver. "Don't you already have one of those?" I ask. "Yes," he replies, "but *this one* does X, Y and Z."

Although I suspect the pure joy of owning a new toy is part of it, I realize that his having a toolbox full of up-to-date, high-quality power tools is critical to his success in his craft. The tools do not replace his knowledge and skills, rather they increase his creativity, accuracy and efficiency.

Learning math and science without the integration of technology would be like trying to do carpentry without power tools.

Instead of being physically and mentally worn down by tedious hours of measuring, sawing, sanding and polishing, he can direct his energy toward designing and re-designing a piece, perfecting the shape of the cut, and bringing the surface to a streak-free lustrous finish. Some of his power tools enable him to do things that would be impossible or impractical otherwise. For example, he can cut boards that are perfectly straight and form exact 90° angles. As a result, he can make kitchen cabinets that are accurate to 1/16 of an inch.

Our own profession of teaching is similar. As master teachers, you and I can work miracles with a piece of chalk and chalkboard or a pencil and blank piece of paper. But how much more could we accomplish if technology were used to free us from routine tasks to enhance our teaching? I used to spend hours every day putting work up on the blackboard, checking student work, finding and creating teaching materials, and writing lesson plans. Then I spent another six hours teaching students. What if I had had access to the Internet, computer applications and instructional software?

Learning math and science without the integration of technology today would be like trying to do carpentry without power tools. Mathematicians and scientists depend on calculators, computers, microscopes, telescopes, cyclotrons, x-ray machines, laser beams and a host of other technologies to collect, analyze and manipulate the data they study. Students who are not exposed to mathematical and scientific technology tools in school are handicapped both in their skills development and in their understanding of math and science concepts.

The best way to learn something is to experience it. Experiencing real math and science activities using the same kinds of tools that mathematicians and scientists use is the best way to learn math and science.

Unfortunately, another similarity between power tools for carpentry and instructional technology for math and science instruction is that they are both expensive. Those $50 drills and CDs and those $2,000 routers and computers quickly add up to a nice chunk of change. Therefore, with limited financial resources, teachers must make some hard choices about what to buy. My recommendation is that teachers base decisions on:

- the **curriculum**, that is, what your learning objectives are for your students,
- the **quality** of the product and its potential for enhancing your teaching, and
- its **appropriateness** for your students' developmental and skill levels.

But begin with matching the curriculum. A product can be exciting, but if it is designed to teach biology concepts and you are teaching earth science, it is worthless for your purposes. If it is designed for high school students and you teach kindergarten, or it is at an eighth grade reading level and your students have trouble decoding simple texts, it will not work either.

Instructional technology programs have come a long way from the boring drill and kill programs of the 1970s and 1980s. Software products are now the most common medium, but videos and laser discs continue to be popular and practical for many users. In Part I of this article I describe several

Power Tools - continued on page 4

Did You Know?

"In 1990-91, 40 percent of high school mathematics courses in high poverty schools were taught by teachers with no expertise in math, who were teaching 'out of the field.' Similarly, while 69 percent of math classes in low-minority schools were taught by mathematics majors, only 42 percent of these classes in high-minority schools were so taught."

"Fortunately, there are some schools and districts that are responding to their poor and minority students, not by lowering standards, but by accelerating learning. These schools are proving every day that poor and minority youngsters will achieve at the highest levels if they are taught at the highest levels."

— *Education Watch, The 1996 Education Trust State and National Data Book* (The Education Trust, 1997)

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kinds of instructional and application programs of interest to math and science teachers.

Promising Instructional Programs

I have categorized instructional programs into six categories: *test preparation, tutorial, games, reference, problem solving,* and *application and modeling tools.* In general, these categories are sequenced from what I consider to be the least desirable to the most desirable in terms of their potential for increasing student learning.

The programs that are least desirable tend to be the easiest for teachers to learn to use, whereas those that are most desirable are effective only in the hands of knowledgeable, creative and dedicated teachers. On the other hand, the more difficult and desirable programs tend to stimulate and maintain student interest for longer periods of time.

Test Preparation Software

Test preparation software that submit students to hundreds and thousands of items similar to ones they will experience in standardized testing situations are popular. There are several companies, for example, that market Texas Assessment of Academic Skills (TAAS) test practice programs. Many schools hope that test scores will rise on the acquisition of such software, and they do not buy or use anything else.

Like the traditional worksheets and books that prepare students for tests non-electronically, these programs do not teach students new information or skills. They merely test or measure knowledge and skills that students already have.

Some exposure to these programs a few weeks before a scheduled test can help familiarize students with specific test formats and help them practice generic test-taking strategies. But the programs should not be substituted for programs that can help students learn new skills and information.

Tutorial Software

The grandchild of the first drill and practice programs, today's *tutorial* software, teaches a sequence of lessons much like those found in textbooks. Because of their sequential nature, math tutorial programs seem to be more useful than science tutorials. I recently experienced a breakthrough in my own understanding of functions in algebra and statistics because of a well-developed sequence of algebra lessons, *Boxer Intermediate Algebra* (Boxer Learning Inc.).

Be aware, however, that if the program merely reproduces a math or science textbook approach, you would be better off just buying the book. Look for programs with hint systems that provide increasingly more specific clues to answers and programs that use multimedia components well. The incorporation of full-color graphics, photographs, animation and video segments, high quality sound, and buttons or hypertext that link one part of the program to another can increase student interest and comprehension if the lessons are well designed and use the multimedia components for learning purposes, not just for entertainment value.

Tutorial programs are designed for individual students. They typically have systems to keep track of lessons each student has gone through and how well he or she did on practice questions and problems. This feature can be valuable to teachers who need or want to monitor the individual progress of students.

Games Software

A lot of instructional software use games to teach skills and concepts. *Games* software can be subdivided into *arcade-type games* and *adventure-style games.* Arcade-type games are usually used to teach skills that require a lot of practice such as instant recall of math facts.

Another common factor in these games is the race against time. If you have students who have not mastered some necessary basic skills such as addition, subtraction, multiplication and division computation, these games can be useful because they sweeten the practice pill, making it easier to swallow. However, like test preparation software, games software should not constitute the core of your instructional technology materials.

Adventure-style games tend to be more cognitively complex and interject an element of fantasy. There is often a story that serves to move the action forward. Sometimes the story can overshadow the learning purposes of the program. Teachers should watch for this possibility when previewing these programs.

Other adventure-style programs do a good job of meshing story and learning objectives. A classic example is *Amazon Trail* (The Learning Company) in which students travel through a rainforest and backwards through time. They must decide what to take with them to increase their chances of survival and interact with several characters to gather important information for their quest. Along the way they acquire academic skills in the areas of history, geography, geology, biology and anthropology. Probably the most effective way to use these kinds of programs is with

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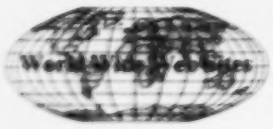
EDUCATIONAL WEB SITES



Boxer Learning, Inc. www.boxerlearning.com
Carina Software www.carinasoft.com
Center for Occupational Research and Development www.cord.org
EdulogiX Interactive www.edulogix.com
EPIC Center: Decision Development Corporation www.epicent.com
Exceller Software Corporation www.exceller.com
HandiLinks to Software – Education www.ahandyguide.com/cat1/s/s198.htm
Intercultural Development Research Association www.idra.org
The Learning Company www.mecc.com/TLC/default.htm
Math Type www.mathtype.com
Mathematica Documents http://store.wolfram.com/catalog/mathematica
Sienna Software Inc. – Starry Night www.siennasoft.com
STAR Center* (Support for Texas Academic Renewal) www.starcenter.org
Team Labs: Personal Science Laboratory www.teamlabs.com
Tom Snyder Productions www.teachtsp.com/index.html
Vernier Software www.vernier.com
Video Discovery www.videodiscovery.com/vdyweb/home/catalog.htm

– Compiled by IDRA

*The comprehensive center funded by the U.S. Department of Education to serve Texas via a collaboration of the Intercultural Development Research Association, the Charles A. Dana Center at the University of Texas at Austin, and RMC Research Corporation.

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cooperative teams or by using whole class discussions for decision making.

Reference Software

Reference software, videos and laser discs provide students with data bases of information on topics of interest. Since CD-ROM players have become more common in homes and schools, software manufacturers have developed a wealth of programs in the general knowledge and science areas at reasonable prices.

Encyclopedia Britannica, National Geographic, Discovery Channel, NASA and the San Diego Zoo are just a few of the institutions that have created or contributed to reference CDs, videos and laser discs. These programs provide extensive text information and include high quality illustrations, diagrams and photographs. Not limited by space, time or size, these graphics can take students to otherwise impossible places such as inside a human brain, to the surface of Mars, within a DNA molecule or inside a combustion engine. Many of these programs now offer linking features so that students can move freely from topic to topic according to their interest.

Reference CDs are useful to teachers who like to build their own background knowledge, who wish to explore topics with their students in depth, or who like to have their students engage in group or individual research activities. Reference programs should be carefully matched to curricular content and student developmental level. A CD on the nine planets of our solar system might be spectacular, but it is not needed for a botany classroom.

The award-winning *A.D.A.M. Comprehensive Student Edition* (A.D.A.M.'s Web World) program provides fully-dissectible illustrations, pinned atlas images, cadaver photographs, radiographs and three dimensional models of the human body's systems and structures in four views and three magnifications. The program is designed for university and medical school students and would therefore be too sophisticated and complex for elementary students who would probably benefit more from the *A.D.A.M. The Inside Story '97 School Edition* program.

Problem Solving Software

Problem solving programs can be excellent vehicles for applying knowledge and skills already learned or for learning new knowledge and skills within the context of solving a problem. The latter approach is the more daring, innovative one and also the one that promises the most punch for your instructional time.

The *Math at Work* series (Center for Occupational Research and Development), for example, features CDs in which students apply pre-algebra through geometry skills to real-life challenges. In *Pooling Around* – one of the *Math at Work* titles – students try to complete the construction of a swimming pool or spa on time and under budget. Acting as the general contractor, they create a job schedule for subcontractors, calculate the building materials required, and deal with unanticipated obstacles such as equipment breakdowns and subcontractor mistakes and delays. In addition to practicing decision-making skills, students learn geometric concepts for two and three dimensional shapes, use scale drawings, and perform geometric calculations and measurements.

Science Sleuths (Video Discovery), which has been a laser disc series, is now also available as a CD program. In *The Volume 2: Mysteries of the Biogene Picnic* – one of the four problems in the series – a number of people who attended the company picnic are experiencing alarming symptoms such as severe nausea and vomiting. Students must figure out the cause of their medical distress by reading newspaper articles, exploring data bases (such as one that lists the effects of various chemicals on the human system), and using a variety of lab tools such as thermometers, ph meters, scales and chemical analyses on objects found at the picnic.

The eighth grade genetics unit of *Social Science 2000* (Decision Development Corporation) explains the problem of the "lost children of Argentina." During the Peronista regime, many Argentines were kidnapped and killed by the dictator's secret police. These *desaparecidos* left behind them several hundred children who had living grandparents but no parents. After the regime ended, *los abuelos* began to locate and identify their lost grandchildren through applying the principles of genetics and heredity. In the genetics unit, students use the data base of genetic characteristics of the children and the grandparents and the principles to reproduce the matching process.

All of these programs, like the adventure-style game programs, will be most effective if students work cooperatively to solve the problems posed to them. Tom Snyder Productions markets software and video discs in which cooperative learning is at the heart of the problem-solving process. *The Great Solar System Rescue, The Great Ocean Rescue, Rainforest Researchers* and the *Science Court* series are among the science titles it produces.

Application and Modeling Software

Application and modeling tools are the most open-ended of programs because students usually enter the data themselves for the simulated or real-life problems they are studying. These programs enable students to play "what if...?" in a safe, simulated environment. There are generic tools such as spreadsheets and graphing programs that can be applied to a wide variety of investigations. Other tools are more specific to the topic such as specially designed geometry and physics tools.

Many math and science teachers use spreadsheets and graphing programs to help students determine patterns in the real world. For example, students can drop a rubber ball from different heights and count the number of bounces it makes before it stops. They can sprout beans and measure the plants' height on a daily basis. They can roll a pair of dice 100 times and see how many times they roll a particular number.

In all three of these cases – one from physical sciences, one from life sciences, and one from probability studies – students can record numerical data that they can enter into a spreadsheet or graphing program. Spreadsheets display information in table form and can incorporate formulas that describe the relationships between cells or individual bits of data. Graphing programs can convert numerical data into a variety of visual displays. These displays can make clear simple relationships (such as greater-than and less-than seen in bar graphs and pie graphs) and complex relationships (such as those manifested by positive correlations and normal curves). Both tools can help students form the rules by which functions are governed.

Specific tools have been designed for investigating principles in probability, algebra, geometry, physics, astronomy and chemistry. Some well-known software packages of this kind are *The Geometric Supposer: Triangles* (Sunburst Communications), *Interactive Physics* (Knowledge Revolution) and *Starry Night* (Sienna Software). With a set of geometry tools, students can draw lines, rays, segments and angles, labeling the points with the traditional A, B, C designations. They can

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What is the Matter with Math Scores?

Cathy Seeley, Ed.D.

It is easy to worry about recent newspaper reports on the Third International Mathematics and Science Study (TIMSS) results. The performance of U.S. 12th graders is abysmal compared to the rest of the world, even for our top students. The TIMSS data are not particularly surprising given the pattern of the TIMSS data released in prior months showing U.S. eighth grade students performing at a fairly mediocre level and U.S. fourth grade students doing somewhat better (TIMSS, 1998). But that is not the whole story. During the last few years, there has been good news about test scores as well.

Performance of U.S. students on our own National Assessment of Educational Progress (NAEP) continues to show growth at every level, with Texas making major gains, especially at the fourth grade level (NAEP, 1997; Fuller, 1998).

In terms of the Texas Assessment of Academic Skills (TAAS), all groups of students improved ever since the TAAS replaced the TEAMS test in 1990, with even greater gains since copies of each test were released beginning in 1995. This improvement includes students at every grade level. Disaggregated data show that gains are noteworthy even within groups broken down by gender, ethnicity, and free- and reduced-price lunch program status (TEA, 1997).

Nevertheless, we continue to see significant disparities in performance among these groups on other assessments at the state and national levels.

So, what is working and what is not?

What is Working

In many classrooms, teachers have made positive changes in the mathematics they teach and how they teach it. Based on the best thinking of the mathematics education community, these teachers have: tightened the mathematical focus at every grade level, provided the depth of understanding students desperately need, found appropriate ways to use powerful tools such as computers and calculators to elevate the level of mathematics students address, and incorporated all of this within a healthy balance of basic skills and more complex thinking and problem solving.

Students in these classrooms are actively engaged in learning mathematics, by writing about, discussing and demonstrating important mathematical ideas and problems. They know how to work alone and in small groups to extend their learning.

> ***In many classrooms, teachers have made significant positive changes in the mathematics they teach and how they teach it.***

Even teachers who have always done a good job teaching mathematics have recognized that they must continually improve and shift what they do to prepare their students for a rich and varied future.

Most of these teachers did not start out teaching this way. In their teacher preparation programs, they – like most other teachers – learned that a well-prepared teacher of elementary or secondary mathematics was one who could clearly explain mathematical procedures and manage large group instruction. They learned about the traditional redundant mathematics curriculum that does little to extend what students know and focuses instead on fragmenting mathematics instruction digit by digit to increasingly larger numbers with essentially the same computational rules as the year before. Even though this traditional curriculum has included some non-arithmetic strands of mathematics, most teachers have had too much to teach and, many of these other topics were never addressed in depth – or at all.

Several factors contribute to teachers' ability to improve their teaching and their students' learning. Certainly, effective professional development is critical to improving what happens in mathematics classrooms. In Texas, a statewide network of professional development in mathematics and science makes such quality professional development available and cost-effective for educators throughout the state (Texas SSI, 1997a). This program provides a series of modules and institutes focused on the Texas Essential Knowledge and Skills (TEKS).

The TEKS themselves can provide a powerful positive influence on what happens in classrooms. They represent a strong consensus-based mathematics curriculum that has somewhat sharpened the focus of mathematics instruction at every grade level. They are comprehensive yet forward-thinking. The TAAS will reflect these TEKS as of spring 1999, thus providing a positive driving influence on classroom instruction.

What is Not Working

In some schools, concern about student performance on measures such as the TAAS have led to less than constructive approaches, to say the least. It is useful for teachers to know what will be assessed, but it is not useful to overemphasize exercises that look like sample test items. It is both

What is the Matter – continued on page

National Assessment of Education Progress 1996 Mathematics Test

Students	Fourth Grade		Eighth Grade	
	National Average	Texas Average	National Average	Texas Average
All	222	229	271	270
African American	200	212	242	249
Anglo	231	242	281	285
Hispanic	205	216	250	256
Students in Title I Programs	200	213	244	249
Students in Free- or Reduced-Price Lunch Programs	207	215	252	252

Source: *1996 Mathematics: Report Card for the Nation and the States*. National Assessment of Educational Progress (Washington, D.C.: Office of Educational Research and Improvement, U.S. Government Printing Office, February 1997).

What is the Matter - continued from page 6

dangerous and inadequate to so strongly stress the TAAS that teachers are told to have their students practice TAAS-like items to the exclusion of all other instruction. Even if short-term gains may appear (which is not always the case), these gains cannot possibly serve students as they progress through the mathematics curriculum.

Trying to build a brick house on a foundation of shaky twig supports can only lead to trouble. As students attempt to learn the mathematics that come in the next grade or the one after that, they are forced each time to memorize fragmented rules and procedures since they do not have the deep understanding that would enable them to anchor their learning and make their memorization more efficient. Not only will they learn only a shallow level of mathematics, but their future test scores may also be in jeopardy as their misconceptions and forgotten facts multiply.

In some schools, teachers work primarily in isolation from each other, each trying his or her own strategies and approaches, sometimes with different programs and materials. This piecemeal approach to teaching may provide a high degree of teacher autonomy, but it accomplishes little for students who progress from one philosophy to the next, from one program to the next, or from one set of standards to the next. There is little opportunity to build on what students have previously learned. Teachers are likely to become frustrated and give up their efforts when they operate without the interactions with and support from each other.

Furthermore, some teachers, administrators, parents and students continue to operate with a belief system about who is able to do what in mathematics. We have believed the myth that only certain students can think at a high level and only certain students can think mathematically. We have bought into the idea that every student needs to be proficient in arithmetic before he or she can do anything else more challenging and interesting in mathematics, in spite of mounting evidence to the contrary.

For example, a middle-aged man I met recently – who I will call "Robert" – confessed to me that he did not yet know his multiplication facts. He thought he might have a learning disability since he never could figure out how he was supposed to memorize them. In spite of this lack of computational facility, Robert had earned a bachelor's degree in physics, a master's degree in economics, and a doctorate in electrical engineering. He travels around the world designing computer chip manufacturing plants, without knowing his multiplication facts.

We simply know better than to withhold the best part of mathematics from students just because they cannot yet recite their facts or do long division with three-digit divisors. And we surely know better than to assume that only certain students can do well in mathematics.

With varied instructional approaches (especially emphasizing mathematical communication, connections, reasoning and problem solving), there is no reason any student cannot learn far more mathematics than we have ever thought possible. We cannot let our inadequacies handcuff students. For every student we might judge as unable to learn mathematics, some teacher somewhere can disprove that judgment. Thank goodness.

What is Next

How can educators do what is best for every student? Educators must deeply examine beliefs about students and mathematics. When teachers and administrators say "All students can learn," how is this statement implemented for the least successful students without holding back the most successful?

Teachers must be armed to make professional decisions by participating in ongoing high quality professional development.

Teachers should be supported in selecting quality instructional materials that support their philosophy and the standards they are implementing, such as the TEKS (Texas SSI, 1997b).

Teachers should learn the most effective teaching approaches possible to

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Power Tools - continued from page 5

then bisect the lines and angles or create parallel and perpendicular lines. The program also measures angle degrees and lengths of selected segments. Using formulas, students can calculate areas and perimeters. Now the fun begins. Students can create triangles and see how the lengths of sides and angles vary and see the relationships between sides and angles. They can work with parallelograms and see how base and height affect area and perimeter.

Through experimentation, guided by the teacher, students can discover a host of basic geometric principles. As with using math manipulatives, students understand concepts more profoundly and therefore retain them better than through the usual textbook, paper and pencil-only approaches.

A probability example may help us see this better. I have taught elementary and middle school students some basic probability concepts by having them roll dice or spin spinners and record their answers. We then notice patterns, such as when rolling two dice, the numbers two, three, 11 and 12 are less probable than six, seven and eight. It usually takes many rolls, however, to establish such a pattern.

With a set of computerized probability tools, I can have the computer roll two dice 1,000 times and record the results in less than a minute. I can import that data into a spreadsheet and then link it into a bar graph and see the pattern clearly in five minutes. In most cases, these computer tools should not replace work with math manipulatives, rather they should serve as an extension of manipulative-based lessons.

A final example is drawn from modeling tools used for chemistry. Students can simulate acid-base combinations, discovering how atomic number and electron composition correspond to chemical combinations. In the process, they may mix two elements that in a real lab would result in an explosion or a toxic gas. In the computer simulation example, they learn about the consequences without risking life and limb. Again, the computer simulations should not replace actual lab work, but can make some otherwise impossible lab experiences possible and accelerate learning about patterns in the real world of science.

In an upcoming issue of the *IDRA Newsletter*, look for Part II of this article where I will address various portable technologies and telecommunications technologies, including the Internet.

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Laura Chris Green, Ph.D., is a senior education associate in the IDRA Division of Professional Development. Comments and questions may be sent to her via e-mail at idra@idra.org

Fifth Annual IDRA

La Semana del Niño

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Pre-institute on Literacy

Monday, April 20, 1998

Critical Issues in Reading Development

This pre-institute on literacy is designed to provide early childhood educators with a whole day of training and preparation focused on early childhood reading. The pre-institute will give teachers and administrators an in-depth view of how reading develops in young learners. Hands-on activities, panel discussions and reflections will be part of this one-day event. Participants will analyze the following critical issues:

- Reading development in pre-kindergarten and kindergarten
- Emergent literacy
- Oral language development related to reading development
- Concepts, strategies and skills needed to become effective readers
- Appropriate literature for young readers
- Shared reading
- How young children become readers and writers
- The role of the native language
- Biliteracy as an attainable goal

School Visits

Take this opportunity to visit model early childhood centers. Institute participants will travel to high-performing, high-minority sites in the San Antonio area that are effectively working with diverse learners. These include Head Start classrooms, a bilingual cluster school, a dual language bilingual program and technology-integrated classrooms.

Concurrent Sessions

Concurrent sessions will be held throughout the institute to provide participants with the latest on language and literacy development. The sessions will be led by practitioners who have tested strategies in the classroom. Participants will select sessions in each of the "key" areas: classroom organization, oral language development, motor development (play and dance), parental involvement, core curriculum, and assessment.

Visit IDRA's web site: www.idra.org!

Monday

Pre-institute seminar featuring early reading and the preschool child. Book signing and wine and cheese reception in the evening with Dr. Carmen Tafolla.

Tuesday

Morning session led by Dr. María "Cuca" Robledo Montecel, IDRA executive director. Carmen Tafolla will be the keynote speaker. She will also present a creative workshop on how to read to children. The first series of concurrent sessions will be held in the afternoon. At another location, hundreds of early childhood educators from across the state will focus on working with families in a distance learning session via video conference.

Wednesday

School visits all morning. The second series of concurrent sessions in the afternoon will be presented by administrators and teachers from successful early childhood programs.

Thursday

School visits all morning. The conference will close with a luncheon featuring keynote speaker Ezekial "Zeke" Pérez, the 1997 National Bilingual Teacher of the Year (awarded by Nordstrom and *Hispanic Magazine*). There will also be a folk dancing group to entertain participants during the banquet.

Institute: $75 each (includes reception, institute sessions, school visits, and Thursday luncheon)
Pre-institute on Literacy: $45 each (includes pre-institute sessions and reception)
Reception only: $15

Sponsored by the Intercultural Development Research Association (IDRA). Supporting IDRA projects include the Desegregation Assistance Center – South Central Collaborative for Equity and the STAR Center (the comprehensive regional assistance center that serves Texas via a collaboration of IDRA, the Dana Center at UT Austin and RMC Research Corporation). Hotel reservations can be made directly by calling 210/224-7155.

For more information or a registration brochure contact Hilaria Bauer or Carol Chavez at IDRA, 210/684-8180; e-mail: idra@idra.org.

REFLECTIONS

Eloy Rodriguez, Ph.D.

A CENTRAL ROLE FOR SCIENCE EDUCATION PARTNERSHIP

I have drawn a number of conclusions about effective science education partnerships based on my rewarding experience establishing the *Kids Investigating and Discovering Science* (KIDS) program at the University of California, Irvine (UCI).

I targeted the Santa Ana Unified School District (USD), which has an enrollment of more than 49,000 students, of whom 92 percent are minority and 64 percent are limited-English-proficient (LEP) – the greatest concentration of such students in California.

With colleagues at UCI, I began the KIDS program five years ago to provide Latino children from low-income families with an engaging and challenging university-based science "camp." The focus of the program is project-based learning on topics at the forefront of biology, especially field biology. We want the children to actually envision themselves as young scientists. They wear white laboratory coats and work side-by-side with teachers, research faculty, undergraduate students and graduate students. In this respect, the program is truly an intergenerational model of teaching and learning.

We made our laboratories and field research sites places where children from kindergarten through middle school can discover and investigate the mysteries of science. The university campus has become a place in which low-income children can pose, investigate and answer fundamental questions on such topics as function, adaptation, evolution, gravity, sound, inertia, force, velocity and acceleration in an environmental framework with enthusiastic parents, compassionate student assistants and gifted bilingual teachers from the school district. Bilingualism is crucial for the success of this program since the majority of KIDS students and parents speak Spanish only.

The true partnership is that of the KIDS program and the parents. This sprung from my own experience. My educational success in a poor south Texas school was largely due to my mother's active involvement in PTA and teacher-parent conferences. Therefore, the program insists that parents be made participatory partners in this unique endeavor.

University faculty, graduate and undergraduate students, parents, teachers and principals all consider the KIDS program to be a great success. Evaluation data show this to be true. We have seen that a partnership between the university campus and public schools can enable minority children to experience the joy and excitement of science and can have an enormous impact on the children's learning and interest in science. A clear indicator of success is the students' improvement in their grades at their "normal" school (a term students used to separate KIDS-UCI from their school) and comments from parents indicating that their children are more involved in their studies.

Our basic goal for the KIDS program is to develop a generation of children who learn to think and understand the importance of education in order to go to college and pursue a career in the sciences. The KIDS program is a year-round science partnership between UCI and the Santa Ana USD. In the summer, children from Santa Ana USD schools come to the university campus where they become part of a research university. The effects of this approach have been profound. Outstanding Santa Ana USD teachers who have worked with us in designing and carrying out the program are the children's teachers during the academic year. They tell us: "The KIDS students... value learning about science and see it as very important, fun and challenging," "Both boys and girls have begun to see themselves as scientists," and "I am constantly confronted by the KIDS students with their question of 'when can we go to UCI to study more science?'"

Distinguished minority faculty serve as role models and mentors to the school children and to minority graduate and undergraduate students who work alongside public school teachers in the program. The KIDS students typically have their first minority scientist role models in the university faculty and students. Faculty members visit the children's schools during the academic year, and undergraduates serve as tutors at KIDS schools, continuing to serve as significant role models.

I want to re-emphasize the critical importance of parents as partners. Parents serve as volunteer homework mentors and some are paid to assist in teaching, mentoring and serving as staff. Parent programs are offered at school sites in the community daily after the summer camp ends. The activities strengthen parents' skills in supporting their children's learning. Principals at the children's schools tell us, "These have become some of our most active parents at school. They are eager to share their hopes and their plans for their students to attend college...Most of our KIDS parents are participating in our Parent Institute for Quality Education."

Finally, I want to underscore the value of building on an existing regional infrastructure that has solid community support, if one exists. An important factor contributing to the rapid and continuing success of the KIDS program is that it has been implemented in conjunction with the Student-Teacher Education Partnership (STEP). This is a collaborative effort involving the predominantly minority Santa Ana USD – the largest school district in Orange County – and institutions of higher education and other school districts in the region. STEP has been in existence for nearly 15 years and is nationally recognized as a model of school-college collaboration. It has had support at the highest levels, including UCI's Chancellor and Santa Ana USD's superintendent.

Notable effects of the KIDS science partnership have occurred in the children's' school-year experiences. Teachers tell us, "Many of the KIDS students have become the 'leaders' in their classrooms in the area of science and problem solving." Principals tell us, "Due to the fact that four of our teachers have been KIDS teachers, we've been 'infected' with KIDS philosophy and focus on inquiry." It can and does work schoolwide across all areas of the curriculum.

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Make no Mistake – The Goal is Equity

Bradley Scott, M.A.

The IDRA Desegregation Assistance Center – South Central Collaborative has expanded its name by adding the word "equity." The center is now the *Desegregation Assistance Center – South Central Collaborative for Equity* (SCCE). The change is intended to capture one of the goals of school desegregation that is more difficult to achieve than merely creating racially balanced schools. *Educational equity* speaks to the need to create quality, effective learning experiences and to provide access to those experiences for all students regardless of their race, sex or national origin. The learning experiences must empower students with knowledge, skills and competencies to expand their life options.

This focus and the range of activities that the center has undertaken in school districts throughout Arkansas, Louisiana, New Mexico, Oklahoma and Texas (federal region VI) is not new for the center or for the Intercultural Development Research Association (IDRA).

Several articles in the *IDRA Newsletter* have described educational equity as one of the goals of school desegregation (Johnson, 1997; Scott, 1997; Scott, 1996; Scott, 1995; Scott 1990). The Desegregation Assistance Center – SCCE assists school districts in implementing equity plans that open access to curriculum for all students. An example is the work the center has done to implement the *Playtime Is Science* curriculum at the early childhood and early elementary levels in schools (see Scott, 1994). This equity-based curriculum in hands-on science is undergirded by the philosophy that, according to Educational Equity Concepts (the developers of the curriculum), "Science is for everyone, not just a chosen few." This philosophical position is shared by IDRA.

IDRA's work in making math and science more accessible to girls, particularly to minority girls, has been well documented in several articles (Yánez-Pérez, 1996; Bauer, 1996; Mahoney and Gchachu, 1996; De Luna and Montes, 1995; De Luna, 1995; Salas, 1994; De Luna, 1994; Sosa, 1992).

IDRA's *Engineering, Science and Math Increases Job Aspirations* (ES-MIJA) project helped middle school minority girls become and remain excited about math and science. It addressed a serious educational concern about the low number of girls and minorities pursuing math and science related careers. The Desegregation Assistance Center – SCCE is concerned about this issue and has made it a specific focus of the center's equity planning and school reform agenda for this program year. The center is currently producing a training video on young girls and science that is designed to assist schools in addressing these concerns.

Clearly, we must be pro-active in making schools work for all children, including in math and science. We should make no mistake, the goal is equity, not just legal desegregation.

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***A Central Role** - continued from page 9*

I urge colleagues at other colleges and universities to collaborate with school districts in creating similar programs enabling children to participate in the university scientific life. In these partnerships, the university campus becomes a truly common ground for fostering the love and learning of science.

Eloy Rodriguez, Ph.D., is the James A. Perkins Professor of Environmental Studies at Cornell University. A native of Edinburg, Texas, he is the first U.S.-born Latino to hold an endowed position in the sciences. This article is reprinted with permission from the author and the publication Common Ground.

"Sugar and Spice and Everything Nice..." Gender Inequities in Mathematics

Anita Tijerina Revilla, M.A.

For many centuries, poems and stories have cast boys and girls into two separate categories – girls are sweet and boys are tough. Many societies have encouraged sexist portrayals of the genders. This has led to stereotypes asserting that girls are too emotional and too soft for math and science careers. Some people believe that girls just naturally do not do well in highly technical fields. Despite the success of many women in the field of mathematics, these stereotypes continue to pervade classrooms and workplaces.

Boys and girls are victims of prejudice in the form of unfair treatment and miseducation. This is due in part to stereotypes that penetrate the subconscious (and sometimes conscious) thoughts of teachers, administrators, parents and students in classrooms all around the world.

Historical Women in Math

While many people have little or no knowledge of the historical development of mathematics in different civilizations, there are women who are credited for their contributions to the field. Among them is Hypatia, a Greek woman born in A.D. 370. She was one of the first women in mathematics who was acknowledged by historians of her time. Hypatia was the daughter of a mathematics professor. Her father passed on his passion for math to his daughter and saw to it that Hypatia received an accelerated education. She became a philosopher and mathematician.

Although Hypatia's success was not acknowledged by many leaders of her time, she was well respected and accepted by other scholars. She taught mathematics and philosophy at the university in Athens. She taught students from Europe, Asia and Africa. She made a number of contributions that were either lost or ignored until several centuries later. These contributions include mathematical treatises, astronomical inventions, textbooks and scientific measurement tools. Because her intelligence was threatening and her beliefs were counter to the Christian hierarchy of Alexandria, she was attacked by mobs and was beaten and burned to death in A.D. 415 (Osen, 1974).

A notable female mathematician from contemporary times is Edna Lee Paisano.

Paisano was born in 1948 on the Nez Percé reservation and was still working in the field of mathematics in 1993 when her story was written by Teri Perl in *Women and Numbers: Lives of Women Mathematicians Plus Discovery Activities* (1993). Paisano is a Nez Percé and Laguna Pueblo Native American from Idaho. Paisano was economically disadvantaged. When she was a young girl, her family earned money by raising cows and making moccasins and purses to sell.

Paisano faced the struggle of becoming a mathematician in much the same way that other minority women do. She was forced to make the decision between becoming a mathematician and pursuing a field that would be "useful to her community." She did not realize at the time that mathematics could be useful to her people. In college, she majored in sociology and received a master's degree in social work, which eventually led her to a federal job with the U.S. Census Bureau. She was the first Native American to work for the bureau. Paisano was finally able to use her skills for computer programming and statistics. As a result, she helped her people receive more equitable treatment from census bureau data collectors.

Hypatia and Edna Lee Paisano are among numerous remarkable women who succeeded in spite of the inequities they faced. It is these inequities that IDRA works to keep out of today's classrooms.

Inequities in Schools

In general and across academic subjects, girls have been shortchanged. Myra and David Sadker wrote about the inequities suffered in schools by girls and boys in their book, *Failing at Fairness: How Our Schools Cheat Girls* (1994). The Sadkers describe many situations of struggle, pointing in particular to the lack of interaction between teachers and girls in school, the plummet of self-esteem for girls in their teenage years, the search for self identity in high school, gender barriers to higher education and the miseducation of boys.

For years, the Sadkers have studied sexism in schools and found that many girls are either ignored or belittled by adults and peers. While teachers may not recognize the distinctions they create in the classroom, students begin to internalize and enact the prejudices. For example, girls tend to be silenced or angered by the fact that they receive little attention from teachers, and many children and adults have shown that they accept the status quo. In fact, adults often fall into school age gender roles when they are in classroom settings.

Other problems that the Sadkers mention are the lack of role models, the forcing of gender roles on boys and girls and the lack of adult-based motivation. They further explain:

> While boys rise to the top of the class, they also land at the bottom. Labeled as problems in need of special control or assistance, boys are likely to fail a course, miss promotion or drop out of school...Girls suffer silent losses, but boys' problems are loud enough to be heard throughout the school (Sadker and Sadker, 1994).

Essentially, boys and girls face situations of injustice due to stereotypes, competition and misinformation.

Useful Strategies for the Classroom

According to a study conducted by the Women's Educational Equity Act (WEEA) program and the University of Nevada, there are at least nine areas of need regarding successful involvement of girls in mathematics. They are:

- changing attitudes about math,
- proving the relevance and use of math,
- improving the learning environment,
- increasing access to technology,
- improving spatial visualization skills,
- improving test-taking skills,
- increasing parental involvement,
- working with school counselors, and
- working with administrators and other teachers to promote math (WEAA, 1990).

***Sugar and Spice** – continued on page 12*

Sugar and Spice - continued from page 11

In the publication *Add-Ventures for Girls: Building Math Confidence, Junior High Teacher's Guide*, the authors state:

> At the elementary level, girls often enjoy math and attain achievement levels equal to or higher than those of boys; however, by the time they reach high school, many bright girls become disinterested in mathematics, enroll in fewer advanced math classes, achieve lower math scores than boys on college placement tests, and are less likely to choose careers that are math-related (WEEA, 1990).

WEEA recognizes that there is no one reason this happens, but there are several effective strategies that teachers and schools can embrace to create equitable mathematics instruction. WEEA has created guides for teachers at the middle school and elementary school levels. The strategies that WEEA recommends to change attitudes about math are listed in the box below. These strategies are only the beginning. In the WEEA teacher guides, there are hundreds more along with resources with activities for students of all ages. It is also important to consider race and gender when searching for relevant materials and meaningful activities (Zaslavsky, 1994). The more sense a subject makes in a student's mind, the more enthusiastic he or she will become.

IDRA is dedicated to ensuring equitable education for all students. It offers information and training in the priority area of gender equity. Research and piloting has created some solutions. But these must be embraced by entire school communities to succeed comprehensively.

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Strategies for Equitable Mathematics Instruction

1. Publicly and privately acknowledge students' academic and intellectual accomplishments (not their effort).
2. Make sure that girls get enough practice that they can be confident with their math skills.
3. Use slates or individual dry erase boards to encourage low pressure and spontaneous answers.
4. Structure math learning activities so that all students will be able to achieve success at some level.
5. Incorporate math problems that call for many approaches with several right answers.
6. Provide opportunities for estimating, guessing and checking.
7. Recognize students' math achievement, especially improvement. Create a "math star" bulletin board.
8. Help girls to recognize that it is okay to acknowledge their own mathematical ability without feeling embarrassed or conceited.
9. Create opportunities for cooperative learning and minimize overt competition between classmates.
10. Practice math skills on computers.
11. Overcome personal anxiety about math with resources such as *Mind Over Math* by S. Kogelman and J. Warren and *Overcoming Math Anxiety* by S. Tobias.
12. Turn the tables in class and let students ask the teacher questions about math.
13. Use girls as peer tutors in math.

Source: *Add-Ventures for Girls: Building Math Confidence Junior High Teacher's Guide* by Women's Educational Equity Act Program and the University of Nevada (Newton, Mass.: WEEA Publishing Center, 1990).

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make mathematics meaningful and approachable to a wider range of students than ever before.

Finally, schools can multiply their efforts to improve their mathematics programs by working schoolwide toward common goals, building on a common foundation of beliefs, and utilizing common materials and professional development.

Changing what and how we teach is hard to do. Sound standards, like the TEKS, provide a good starting point, and knowledgeable, confident mathematics students are the end product. Along this road, there is much work to do in every school to understand the mathematics curriculum and learn new strategies for teaching and assessing it. The cost is high, but the investment is essential. Our students deserve nothing less.

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BEST COPY AVAILABLE

Texas Prefreshman Engineering Program: Filling the Pipeline for Workforce Diversity

Manuel P. Berriozábal, Ph.D.

The Texas Prefreshman Engineering Program (PREP) identifies high achieving middle school and high school students who are potential engineers or scientists and gives them reinforcement to successfully pursue college engineering and science studies. Women and minority students are special target groups. The program was created in the summer of 1979 by a partnership of 20 community and senior colleges in 11 cities.

PREP is an academically intense summer program that stresses development of abstract reasoning skills, problem-solving skills, and career opportunities in engineering and science. Participants commit themselves to eight weeks of intellectually demanding classes and laboratories. They complete class assignments and laboratory projects and take scheduled examinations, including a final examination in each course.

All participants are expected to maintain a 75 average or better performance standard during the program. Each student earns a final grade, which is reported to his or her school. Participants can return for second and third summer components.

Since a significant number of minority students come from low-income families, PREP charges no tuition or fees. In this way, low income is not a barrier for applicants. Also, PREP has been designated as a service provider by the local Summer Youth Employment and Training Program (SYETP) sponsors.

Some poverty-level participants can earn at least $800 for their PREP experience. During the school year, many PREP students participate in an academic co-curricular program conducted by the local chapters of the Texas Alliance for Minorities in Engineering.

In 1997, PREP served 2,627 students. The program staff included 160 instructors who are college faculty members, middle school and high school teachers, an Air Force officer, and civilian engineers and scientists. Also, 161 college undergraduates in engineering and science served as program assistant mentors. The administrative and institutional support staff consisted of 67 individuals. The total support was more than $3 million that year. There were 452 participants who received SYETP stipends, and most sites served free lunches to low-income students through the Texas Department of Human Services summer food service program.

Financial and full-time in-kind staff support comes from various sources: local, state and national colleges and universities; military commands; Texas government; Texas Higher Education Coordinating Board Eisenhower Program; NASA; U.S. Department of Energy and other government agencies; public and private industry; professional organizations; individuals; local school systems; and SYETP sponsors.

Many People Had Low Expectations for Minority Students

When PREP first started 19 years ago, the conventional wisdom was that it was doomed to failure because teenage students would never want to spend eight weeks during the summer studying mathematics. Furthermore, minority students would not succeed in this structured and disciplined environment.

In 1979, an article was published in a San Antonio magazine concerning the establishment of an engineering program at UTSA. The article included the following statement: "The Mexican American community is not where engineers come from anyway" (Walker, 1979).

Science magazine dedicated its November 1992 issue to minorities in the science pipeline. One interviewee, who as a high school student participated in an intervention program, commented that we spend too much effort getting students to love science and mathematics instead of preparing them academically to pursue these areas (Sims, 1992).

This is simply a variation on a theme from previous years when our able minority high school students were urged to take shop courses instead of college preparatory courses, so that they could enter the labor force immediately upon high school graduation.

PREP Proves Success is Possible

Now 19 years of operation have belied the predictions. Nearly 14,000 students have pursued PREP; 80 percent have been minority and 54 percent have been women. The high school graduation rate is 99.9 percent, the college attending rate is 91 percent, and the college graduation rate is 87 percent. Fifty-four percent of the college graduates have majored in science or engineering.

Although 50 percent of our students have come from economically at-risk circumstances, PREP has proved that, under the guidance of competent and caring teachers, these students can acquire quality educational preparation to succeed in college. PREP scholars develop skills that are becoming increasingly important in functioning and thriving in our technological society.

Some explanations for the success of the PREP partnership include the following.

- PREP is a well-organized and highly structured mathematics-based academic enrichment program that stresses the development of abstract reasoning skills and problem-solving skills.
- PREP has high but reasonable expectations of its participants.
- PREP staff consist of competent and caring teachers, program assistants and administrators who have a strong commitment to student achievement, in particular to minority student achievement.
- PREP is an inclusive program that welcomes minority students and non-minority students.
- PREP maintains a data base of all of its graduates.
- Each current sponsor and benefactor receives a copy of the annual report.
- As appropriate, sponsors and benefactors receive diskettes and listings – as authorized by our graduates – to use for recruitment opportunities in special programs, college entrance, and permanent or temporary employment.

PREP has received several state and national citations as a model intervention program from

- National Research Council Mathematical Science Education Board Report – *Moving Beyond Myths*,
- U.S. Department of Energy Mathematics and Science Leadership Development and Recognition Program,
- Mathematical Association of America

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SUMMA Project,
- United Negro College Fund,
- Hispanic Engineer National Achievement Award Conference,
- Society of Mexican American Engineers and Scientists (1992 BRAVO Award),
- Ford Motor Company Hispanic Salute,
- Lone Star Showcase and Salute to Community Service,
- 1994 Hispanic Heritage Award in Education,
- U.S. Department of Education,
- Texas Senate, and
- Business-Higher Education Forum of the American Council on Education (1992 Anderson Medal Competition Certificate of Merit).

In 1996, NASA awarded a $1 million grant in support of a collaborative effort of the Hispanic Association of Colleges and Universities (HACU) and the University of Texas at San Antonio (UTSA) to replicate PREP in seven Hispanic-serving colleges and universities outside Texas. In 1997, San Antonio PREP was a recipient of a Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring.

Lessons Learned

We must condemn programs that substitute acquisition of computer manipulative skills for intellectual development. We must support generous college scholarship programs for low-income high school students who excel in college preparatory programs in high school.

As in the PREP program, we must have high expectations of our students. They will learn that through hard work and commitment, they can become educated and productive citizens, masters – not servants – of our technology and leaders of our society.

Resources

Sims, C. "From Inner-City L.A. to Yale Engineering," *Science* (November 13, 1992) Volume 258, 1232.

Walker, T. "The Rise and Fall of UTSA," *S.A. Magazine* (November 1979).

Manuel P. Berriozábal, Ph.D., is a professor of mathematics at the University of Texas at San Antonio and is the coordinator of the Texas Prefreshman Engineering Program. This article is adapted from "The Texas Prefreshman Engineering Program: Filling the Pipeline for Workforce Diversity," proceedings of the 1995 National Symposium and Career Fair of the Society of Mexican American Engineers and Scientists. It is used with permission from the author.

HIGHLIGHTS OF RECENT IDRA ACTIVITIES

In January, IDRA worked with **8,073** teachers, administrators and parents through **88** training and technical assistance activities and **141** program sites in **10** states plus the United Kingdom. Topics included:
- "Countdown 2000: Equity and the U.S. Department of Education's Seven Priority Initiatives," Title IV Desegregation and Equity Centers Conference
- Teacher Renewal
- Two-way Bilingual Program Design Issues and Models
- IDRA *Content Area Program Enhancement* (CAPE) Project
- Focus Group Interview Training

Activity Snapshot

Four campuses in a school district in San Antonio are working together to improve the quality of content area programs for limited-English-proficient (LEP) students. IDRA is helping by uniting teams of content area teachers, English as a second language (ESL) teachers, and campus administrators from four middle schools and junior high schools through the IDRA *Content Area Program Enhancement* (CAPE) project. The project is funded by the Office of Bilingual Education and Minority Languages Affairs (OBEMLA). The teams are focusing on the implementation of curricula and instruction that are culturally and linguistically appropriate. IDRA is providing teacher training, on-site technical assistance, task force facilitation, curriculum development and action research assistance. The new project is expected to impact more than 500 LEP students in the areas of math, science, social studies, English and reading.

Participating agencies and school districts included:
- Hope Public Schools, Arkansas
- Richardson, Independent School District (ISD), Texas
- Pharr San Juan Alamo ISD, Texas
- Donna ISD, Texas
- Oklahoma City Public Schools
- Clovis Municipal Schools, New Mexico

Regularly, IDRA staff provides services to:
- public school teachers
- parents
- administrators
- other decision makers in public education

Services include:
- training and technical assistance
- evaluation
- serving as expert witnesses in policy settings and court cases
- publishing research and professional papers, books, videos and curricula

For information on IDRA services for your school district or other group, contact IDRA at 210/684-8180.

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How Do I WOW You? Let Me Count the Ways...

Anna Alicia Romero

Training is no easy task. Ask any teacher who has had to prepare a lesson for other teachers. Ask any school faculty member who has been sent by the principal to a conference and is expected to report the findings presented there. Ask anyone who has had to conduct a professional development session.

Regardless of how well the trainer knows the topic, preparing a quality training session requires time and careful preparation. For many of us, it is a painful and arduous process.

But I have found out that, armed with the necessary tools, it is possible – and even fun – to prepare and lead a superb workshop with minimal stress.

From *Ysleta Reports* (El Paso, Texas, November 1997): "There was such a positive response to the first *WOW: Workshop on Workshops* training that a second session was held at Central Office. Participants were asked to share some highs and lows of the training. 'Positive ways to impact people while they enjoy learning,' and 'Being able to draw from others' experiences,' were a couple of the comments made by participants."

The WOW

When I first began working at the Intercultural Development Research Association (IDRA), I heard people talking about "WOW" training like it was some sort of rite of passage: "Have you been WOWed?"

They talked about the quality and lasting effectiveness of the training. They talked about how "charged" the participants were at the end of the two-day session. This piqued my curiosity. What is the WOW? I finally asked.

The WOW, it was explained, is the *WOW: Workshop on Workshops* designed by IDRA lead trainer, Aurelio M. Montemayor, M.Ed. It teaches the art of planning and conducting workshops.

A few months ago I had the opportunity to participate in this training of trainers session. I experienced first-hand the intensity of the participation, the wealth of information, and the techniques discussed and applied throughout the two days.

A notebook accompanies the training that is a life-saving reference guide replete with examples of training tools that you can use to ensure your audience can apply the new information you are presenting.

People who have "gone through the WOW" say that their approach to leading workshops has changed forever. One person said, "You made my nightmares about workshops go away." Part of the magic is the unique perspective about adult learning that the WOW offers.

How Adults Learn

Just as *pedagogy* deals with the teaching of children based on how they learn and develop, *andragogy* deals with the teaching of adults based on assumptions of how they learn. Principles of andragogy drive the execution of the *WOW: Workshop on Workshops*.

For example, one assumption is that all adults bring a rich background of personal knowledge and experience that pertain to whatever you want to teach them. Montemayor acknowledges that trainers of adults are often faced with individuals whose past learning experiences may become a barrier. He says that appropriate training bypasses the negative past and concentrates on developing new skills.

One participant stated, "Your workshops have a very unique technique: You bring the good out in every human being." Montemayor asserts that facilitators cannot create a collegial atmosphere if they speak to their participants as if they are not intelligent adults.

Therefore, one of the keys to effective training is to create an interactive, energetic process. Montemayor draws a clear distinction between traditional *lecture-style* teaching and *interactive* teaching. Lecture-style teaching places the learner in a passive capacity while interactive teaching gives the learner importance. It is more flexible, less formal and increases learning. It can also be more

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Androgogical Assumptions about Adult Learners

- ✔ Adults learn most when given responsibility for what is learned.
- ✔ Adults learn fastest when allowed to determine the pace at which they learn.
- ✔ Adults are uniquely qualified to take responsibility for their own learning.
- ✔ Adults bring a rich background of personal resources and past experiences that pertain to whatever you want to teach them.
- ✔ Adults want to have positive self-concepts and to be treated as autonomous, individual beings.
- ✔ Adults want experiences that build on positive issues and success and that minimize limitations.
- ✔ Adults want to be considered basically intelligent, powerful, flexible and able to change when sufficient reason for change is provided.

Source: *WOW: Workshop on Workshops* by A.M. Montemayor (San Antonio, Texas: Intercultural Development Research Association, 1994).

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How Do I WOW You? *- continued from page 15*

difficult to prepare. The WOW makes it easier.

Features of the WOW

The *WOW: Workshop on Workshops* takes the participant through a continuous interplay of action and reflection. In short, the process includes the following steps.

- Assess the needs of the audience.
- Clarify the workshop objectives.
- Select appropriate activities and materials (using the *WOW: Workshop on Workshops* notebook as a guide).
- Evaluate throughout the process.

WOW participants prepare an actual workshop with a team of other participants. They provide feedback to each other. One participant commented that the most productive aspect of the session was the "feedback on our efforts in writing [because] others noticed things I missed." Together, participants learn to apply the elements necessary to create a "well-wrought" workshop.

A safe environment conducive to sharing, learning and productivity is modeled throughout the two days. The WOW presenter makes use of furniture arrangement, humor and paying attention to individuals to maintain a rapport with participants. A teacher adds, "The presenter did an excellent job of making the participants feel comfortable and willing to share; I hope I can develop to that level as a presenter."

WOW: Workshop on Workshops

Coming Soon...

May 7-8, 1998
San Antonio, Texas

June 11-12, 1998
San Antonio, Texas

The registration fee of $150 per person includes the two-day training session and WOW: Workshop on Workshops notebook. Call IDRA for information (210/684-8180).

This rapport is a major theme of the WOW. "Starting from the participants' strengths is 'rock bottom' in terms of modern principles of teaching adults," Montemayor explains.

One of the greatest challenges for a trainer is to make the topic interesting and interactive, using the appropriate techniques that convey the material. Types of activities to facilitate learning include quizzes, crossword puzzles, group discussions, anagrams and "warm-ups" (at the beginning of the workshop to alleviate participants' initial tension). These are fun ways of teaching and reinforcing information.

The *WOW: Workshop on Workshops* is designed to be adaptable to all kinds of adult learners. It is not exclusive to the field of education or to those who already teach or train other adults. In fact, at IDRA we have used the WOW to prepare first-time parent presenters to lead educators and other parents. Others have used it for their businesses, local non-profit agencies and civic initiatives. The beauty of the WOW and its teaching style is its flexibility to the needs of the audience.

Montemayor says the pay-off is a well-planned and well-conducted workshop that is the most concentrated, most efficient and perhaps most elegant means of training adults. "This is one of the best workshops I have ever attended," commented one participant, "I really enjoyed being a part of this fantastic, wonderful, marvelous, unique workshop."

The *WOW: Workshop on Workshops* is the sum of more than 30 years of Montemayor's experience in pedagogical roles – school teacher, political organizer and IDRA trainer. Montemayor's unique process of planning a well-wrought workshop challenges trainers and learners to strive for excellence.

Many elements make the WOW a successful workshop. By trying out the methods, participants learn the art of planning and conducting workshops. More importantly, everyone in the "community of learners" participates and internalizes the lessons – making the themes and techniques part of their actions. They leave better equipped to conduct their own smooth, efficient and successful workshops.

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